PLANNING LAND USE STRATEGIES: MEETING BIODIVERSITY, CLIMATE AND SOCIAL OBJECTIVES IN A CHANGING WORLD

D4.2 – POLICY SIMULATION TOOLS

WORK PACKAGE 4, TASK 4.2

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List of Abbreviations

Term	Description
BAU	Business-as-Usual
CLD	Causal-Loop Diagram
EU	European Union
GA	General Assembly
MC	Multiplier Cluster
PC	Practice Case
WS4	Workshop 4, also known as the Pathways of Change workshop

1 Introduction

1.1 Overview of the Deliverable

This deliverable describes the Policy Simulation Tools, a set of web-based applications (a screenshot of the user interface of the application shown in Figure 1), that were created in Task 4.2 to support the stakeholder engagement activities of the project, the rationale behind their use and the development process of the tools. The tools described here represent the base policy simulations that will be customised according to the local context and needs of the partners and local stakeholders for each practice case and will be used during their respective Pathways of Change workshops (henceforth referred to as Pathways workshop or WS4).

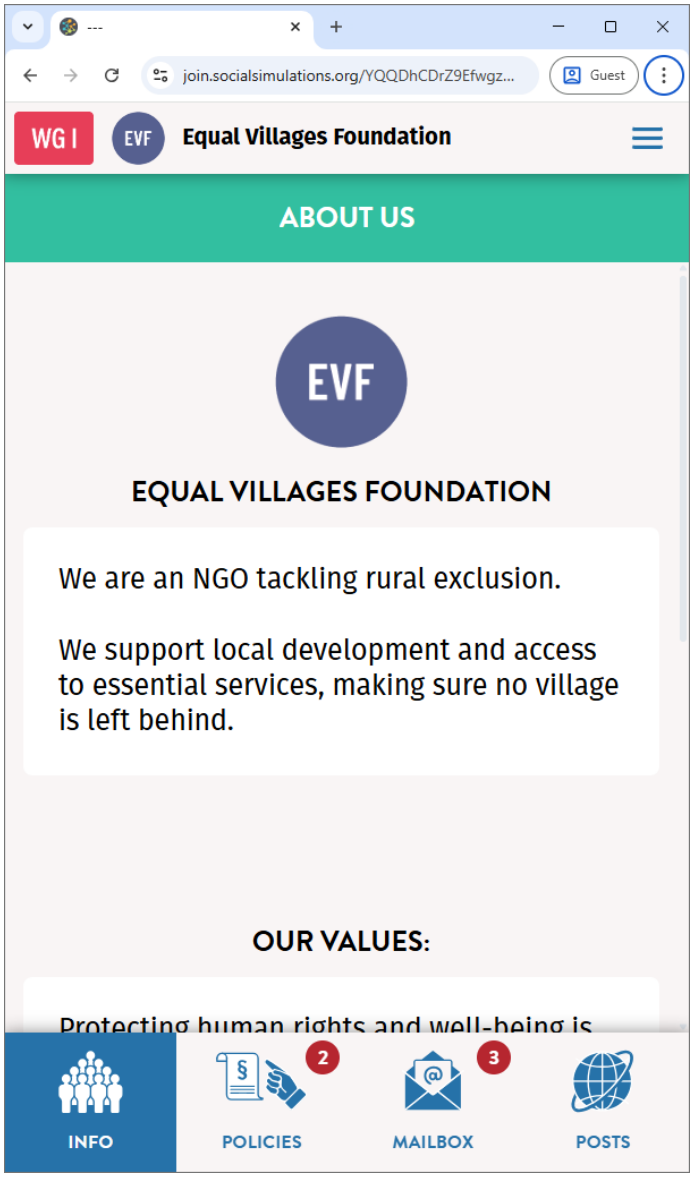

Figure 1. The user interface of the Policy Simulation tool.

1.2 Document Structure

The document is organised as follows:

Section 1 - Introduction: description of the purpose and scope of the document and its structure
Section 2 - Methodology: description of the steps of co-creating the base policy simulation tools
Section 3 - The Policy Simulation Tools: a brief description of the base policy simulation tools and links to their online access
Section 4 - Use in the Pathways Workshop: how the tool will be used in a workshop setting, particularly for the Pathways workshop
Section 5 - Conclusion

2 Methodology

2.1 What are Policy Simulations?

A Policy Simulation involves real-world stakeholders — i.e. experts and practitioners concerned about the future of a region or an organisation — exploring specific real-life policy issues. It is a particular application of a Social Simulation.

A Social Simulation is a tool, and its application is a process focusing on different forms of interactions among the participants (Solinska-Nowak et al., 2018; Stefanska et al., 2011). It is "social" because it requires collaboration between real people representing different groups and organisations. It is a "simulation" because it emulates carefully selected real-world structures and processes. As a tool, it is similar to a multi-player serious game, as it uses many game-like mechanics, but it also resembles interactive theatre, allowing participants to take on different perspectives on emerging challenges, and the goals that participants are trying to achieve are not imposed on them. Instead, participants set these goals themselves: they create visions of their "desired futures" and then collectively explore possible strategies to reach them.

A Policy Simulation allows stakeholders to develop strategic insights by building on selected representations of real-world structures and processes, exploring actual policy issues, analysing real-world data and working on policy development projects and solutions that can be implemented in the real world.

Using the Policy Simulation tool in a workshop or simulation session, and underpinned by the CompleCSus framework that combines social learning with the procedural rhetoric approach to designing game structure (Mochizuki et al., 2021), it becomes an experiential process. In this setting, a group of participants—such as academics, researchers, policymakers, civil society organisations, and the public at large—collectively explore a complex reality. They do so by being immersed in an extended narrative layer or stories, from which they must discuss, negotiate, and make decisions together. The storyline is created based on available scientific data and consulted with experts from the field, and presented using a series of media, such as videos, news articles, social media posts, maps, and infographics. Results of computer models can also be used to provide feedback to participants based on their decisions. As the storyline unfolds, participants work to respond to the changing situation.

2.2 Policy Simulations in the PLUS Change Project

In PLUS Change, we construct policy simulations that provide stakeholder-participants with an environment for exploring possible pathways towards their sustainability and well-being goals amidst climate change. Participants use their knowledge and available data in a deliberative manner to develop policies, strategies or interventions that can lead them to desirable futures, identify challenges, seek solutions, and negotiate trade-offs. In PLUS Change, our use of policy simulations fosters collaboration between stakeholders and scientists in analysing how problems emerge in complex systems and where points of policy intervention and social innovation might apply.

2.3 Development process

2.3.1 Understanding the past and present

To understand the evolution of land use change in the practice case (PCs) areas up to the present, we reviewed the outputs of the Project's Workshops 1 and 2. This provided us with insights into how different factors, such as the socio-political contexts and extreme weather events, shaped land use, as well as the current land use and change priorities of each PC.

We also examined the outcomes of the Possible Landscape workshops and extracted the main issues or concerns of the stakeholders, as well as the trade-offs, between choices of land use, to highlight the tensions that the PCs face regarding land use change as they strive to reach the visions identified in their respective Possible Landscape workshops. We listed the push and pull factors, as well as the realities, when making these choices, such as the current EU policies and strategies related to land use, checking their consistency with the PC-level causal-loop diagrams (CLDs) reported in D3.2 Report on the policy drivers of land use change (PLUS Change Project, 2025a). We verified and validated the information that we have collated from the preceding project workshops with the PC partners.

In parallel, we conducted research to understand the historical and contextual factors of these land-use changes at the European level to get a bigger picture of the evolution of land use in the EU. We also examined the current mainstream discussions and discourses surrounding land use and land-use change to learn how they are being framed.

2.3.2 Clustering the Practice Cases

It was not feasible to develop one policy simulation from scratch for each of the twelve PCs and the multiplier cluster (MC) within the available resources; thus, it was planned to create base policy simulations that could be customised for each PC. It was necessary to cluster the PCs such that each cluster is represented by a base policy simulation. The clustering process was done with the support of the PC coordinator.

Clustering the PCs proved to be a challenge due to a myriad of factors, such as differences in the scale of the PC, the type of PC partners overseeing the cases, the type of actors or stakeholders involved, and the variety of geographic or topographic features or landscapes encompassing the PCs, among others. With these challenges, we opted for a different approach in which we clustered the most critical issues identified by the PCs, which resulted in the following clusters of topics: 1) rural land use as a source of well-being/income for local communities, 2) urbanisation, and 3) nature and water.

With these clusters and the resulting base simulations, the simulations can be made modular. This means that if a PC faces cross-cutting or landscape issues—such as urban sprawl in peri-urban zones—it can incorporate elements from any or all of the base simulations, making them more flexible and easier to customise for each PC.

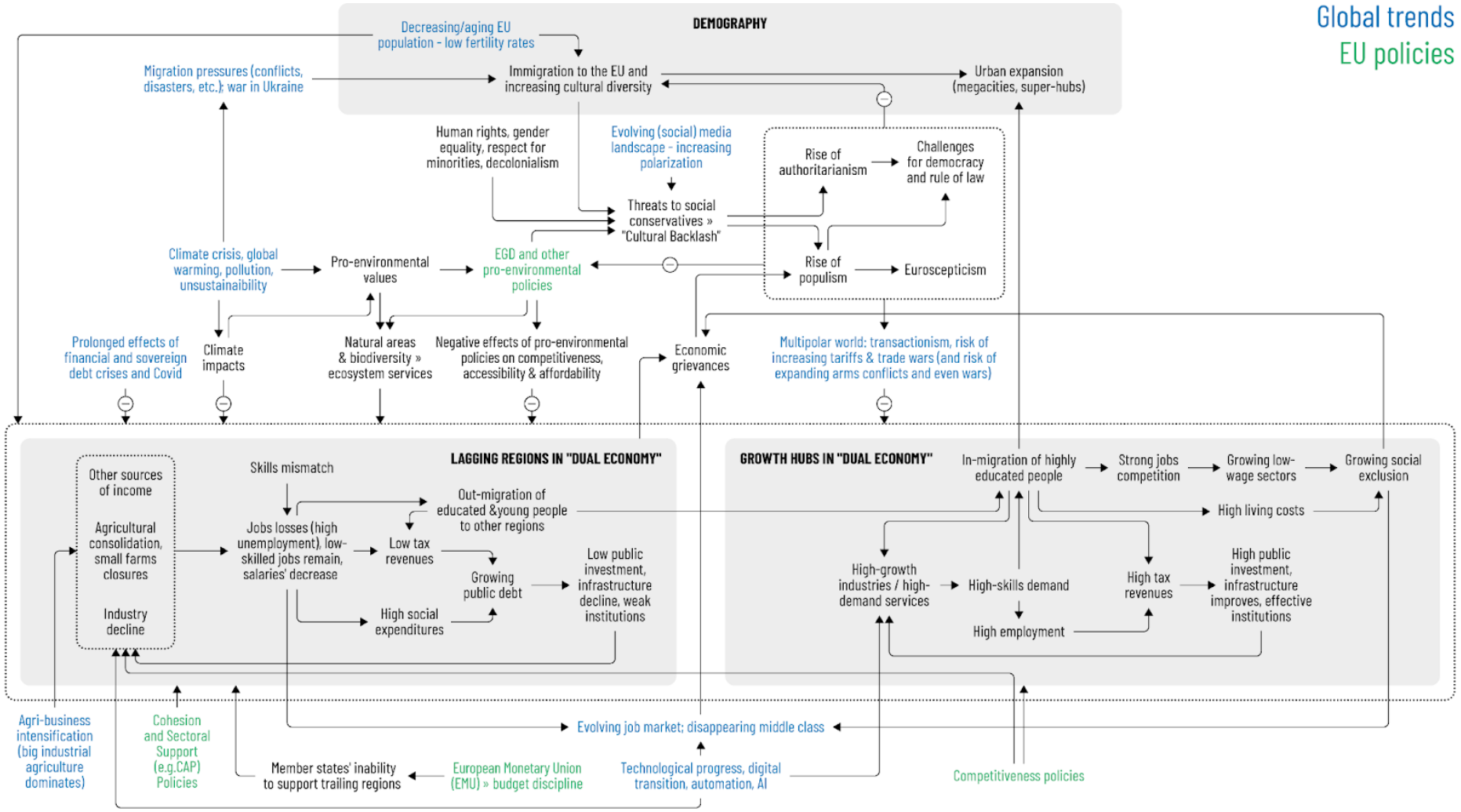

Figure 2. Conceptual diagram of the current state of affairs in the EU related to land use and land-use change.

2.3.3 Creating the narrative layer for a future scenario

As a next step, we constructed a conceptual diagram of the current state of affairs in the EU related to land use and land-use change (Figure 2) that takes into account past events, while representing the current situation, including recent events and current discussions or discourses. This diagram was inspired and guided by the concept of a "dual economy" (Rodrik, 2022; Smit et al., 2022) coupled with the unequal regional development and stagnation in Europe (European Commission. Directorate General for Regional and Urban Policy., 2024; Pilati & Hunter, 2020). Its consistency was also checked against the EU-level CLD produced in Task 3.2 (PLUS Change Project, 2025a). We verified and validated this diagram with the research partners in WP2 and WP3, the PC coordinator, who has expert knowledge of the discussions, decision-shaping and decision-making processes at the EU level, and the Project Ambassadors. The Ambassadors were also asked to indicate missing information or issues that are being discussed in the community they represent in the project, particularly those topics that they perceive as important, but often left out in mainstream discussions. The feedback obtained from this process served as the basis for the further refinement of the diagram.

From the refined diagram, we developed storylines of the plausible future of the EU related to land use change one year later from the present, including socio-political events and effects of climate change, assuming a business-as-usual (BAU) scenario.

At the PC level, we asked each PC partner to verify the most critical topics or issues that their respective PCs are focusing on based on their respective Possible Landscapes session. We aim to make our tool as relevant and useful to the PCs as possible; therefore, we acknowledged and accommodated any changes to these topics, knowing that the PCs' and the PC partners' contexts and needs can change over time. Their chosen topics would be the main focus of their Pathways workshops, while a synthesis of these issues or topics was used as the basis for creating the base policy narratives for each cluster, and was used in the pilot session held during the Project's May 2025 General Assembly (GA), which is described in the next section.

From these topics, we also asked the PC partners to identify the main topographic features, land uses and land cover that encompass the issues to ground these topics or issues onto specific geographic features. These geographic features were composed into stylised geographic maps (example in Figure 3), which were used in the narrative videos of the policy simulation (discussed in more detail in the next section). Additional graphical elements in the stylised maps were added in the video to illustrate the "before" and "after" states of the landscapes in a BAU future scenario.

(a)

(b)

Figure 3. A portion of the map showing the (a) "bird's eye" view and (b) landscape view.

2.3.4 Putting together the simulation tool

Here we describe the process of constructing the policy simulation tool that was used for the pilot session held during the Project's May 2025 GA. As there are twelve PCs and an MC, the pilot simulation cannot delve deeply into each of the PCs. Instead, we created a fictional region, *Verdaterra*, which is a stylised version of the EU and the PCs that also accommodates most of the concerns and issues of the PCs at the three clusters. This was done to create an engaging narrative while ensuring the inclusivity of the policy simulation during the GA, such that each PC can be identified with or related to within the narratives depicted in the simulation. As such, the general structure of the policy simulation in this fictional region depicts or represents two levels of land use and land use change: 1) the European level, which serves as a backdrop and context to which the PCs operate, and 2) the level of the clusters representing the most pressing issues of the PCs. This is to explicitly acknowledge the links or feedback loops between European-level events and decision-making with those occurring locally at the PC level.

The policy simulation tool is composed of several elements that, when put together and operationalised in a specific sequence by the facilitators, constitute the simulation experience. Specifically, the elements of the simulation tool are:

1. Proprietary web-based application, accessible on computers or portable devices such as a tablet or mobile phone, where participants can submit their policy, strategy or

intervention propositions and vote on them, as well as receive supporting materials digitally to help their decision-making.

2. Roles that are selected by the participants at the very beginning of the simulation as part of the immersion process. The roles embody different perspectives or discourses on the same issues or topics, and are represented as different types of stakeholders as identified in D4.1 Intervention points for creating land use policy and decision-making change (PLUS Change Project, 2025b), allowing participants to walk in another person's shoes. Role selection is the first view of the web application.

3. Videos that set the stage and drive the narrative of the simulation forward.

4. Pre-made policy or intervention propositions, delivered in the form of emails in the web application, to start the discussions. These solutions provided to the participants are not intended to be extensive but rather as starting points for discussion.

5. Other forms of media, such as social media posts and newspaper headlines, which can carry additional information, can be deployed in the web application. They can be used to represent voices or perspectives that are not present or represented during the simulation session.

The simulation tool is set within the simulation narrative in which the participants take on the roles of stakeholders of *Verdaterra* (a sample screenshot of the application used during the pilot session is shown in Figure 4), who are engaged in a bottom-up initiative – *Verdaterra Future!* – in which they will have to work with each other in developing solutions to the key challenges of the region. The roles represent the prevailing discourses surrounding these key challenges as portrayed in mainstream media, such as in news reports and social media posts, in and around Europe.

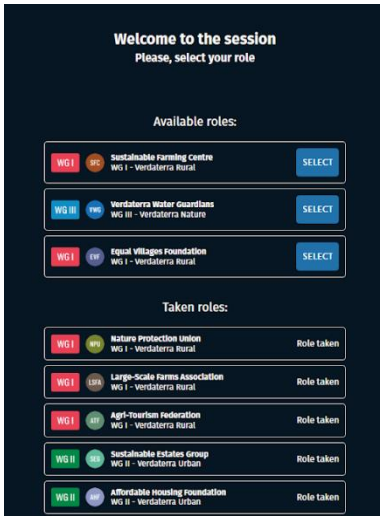

Figure 4. Screenshot of the application showing where participants can select their roles in the simulation.

Setting the scene of the simulation, or what we call world-building, we created videos telling a story of *Verdaterra* (a sample screenshot shown in Figure 5), which is based on the narrative

created using the EU-level conceptual diagram (Fig. 2). We also created videos for each of the topic clusters identified earlier. The scripts for these videos were written with the support of the ChatGPT software (OpenAI, 2025).

Figure 5. Screenshot of the opening video as part of the world-building for *Verdaterra*.

Based on the identified critical topics or issues identified by the PC partners, we created several intervention propositions to address them. These were delivered in the form of "emails" by fictional organisations lobbying for these propositions to be enacted. These propositions are meant to be suggestions or conversation starters for the working groups representing the aforementioned topic or issue clusters. Through the web application (a sample screenshot of the application used during the pilot session is shown in Figure 6), participants can and are encouraged to co-create their own propositions and vote on them.

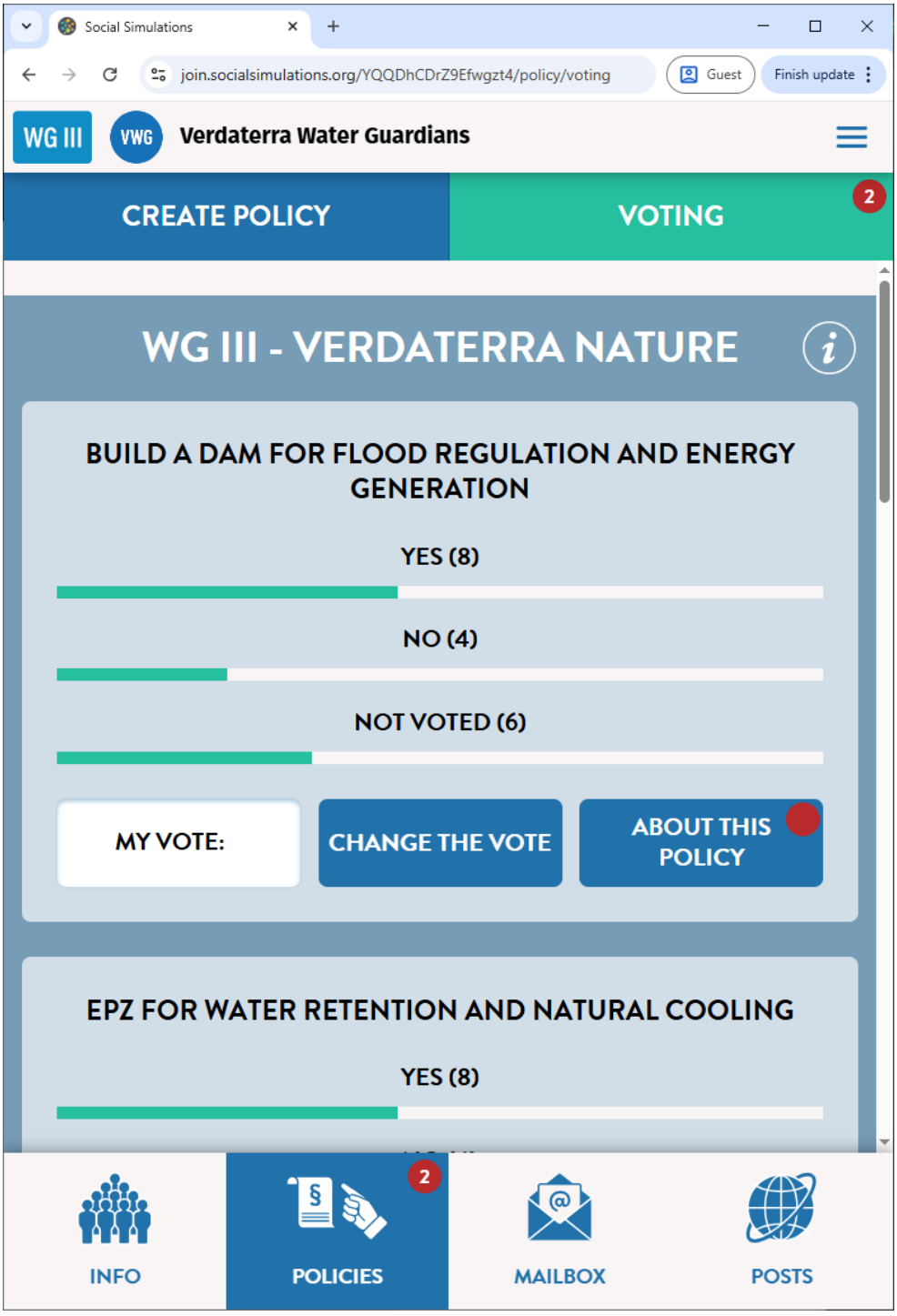

Figure 6. Screenshot of the application showing where participants can cast their votes on the propositions.

3 The Policy Simulation Tools

In the base simulations described below, the participants are immersed in a situation in which they, as a community, need to address the complex challenges of land use change towards sustainability and improved well-being amidst climate change. Unlike the policy simulation piloted at the 2025 GA, where the exercise was framed within a fictional region, Verdaterra, the simulations for the PCs will be focused on their respective contexts and needs, which may not necessarily be the same with each other. As such, the decision to use the concept of the fictional region Verdaterra and the role-playing aspects connected to it is left in the hands of the PC partners.

The base policy simulation tools are delivered in the form of web-based applications. While the applications are hosted on the Centre for Systems Solutions' server, the links to access the web application are publicly available. The policy simulation tools require back-end operation, usually by a facilitator of the simulation session or workshop. With this in mind, most of the content found inside the policy simulation tools can be viewed through another web-based application called Self-Exploration, which is also publicly available.

3.1 Base simulations

3.1.1 Rural land use as a source of well-being/income for local communities

This simulation revolves around topics and issues surrounding agriculture, namely, farmland abandonment and consolidation, agricultural intensification, and agroforestry, and topics and issues on tourism and regional identity. These are meant to reflect the opportunities and challenges of generating income and improving well-being in rural landscapes, and are showcased in a video (a sample screenshot of the video is shown in Figure 7).

Figure 7. Screenshot of the video for the cluster on rural land use.

The pre-made solutions or intervention propositions focused on the establishment of a match-making platform for abandoned or underused land with potential new users, and a proposition to establish a framework for fair distribution of tourism amenities and the introduction of a tourism tax.

This base simulation can be accessed at: https://engage.socialsimulations.org/PLUSChange-Rural

3.1.2 Urbanisation

The simulation on urbanisation focuses on the linked topics of urban sprawl and greenbelts, and social exclusion in the context of growing cities. The video (a sample screenshot of the video is shown in Figure 8) was created to show the challenges of addressing the issue of urban sprawl, and that one of its solutions, establishing greenbelts, faces its own drawbacks despite its positive impacts. The most vulnerable often suffer more when faced with these challenges, as they do not have the means or capacity to do so effectively; thus leaving them with very few options. All the while, even under such contexts, there are still underutilised spaces, such as brownfields.

Figure 8. Screenshot of the video for the cluster on urbanisation.

The suggested solutions were focused on how to best utilise underutilised built land resources, especially for neglected neighbourhoods, through a match-making system, and imposing a housing density quota before allowing building into other areas.

This base simulation can be accessed at: https://engage.socialsimulations.org/PLUSChange-Urban

3.1.3 Nature and water

The nature and water base simulation are about the expansion of forest lands, often at the expense of agricultural lands, and the advantages and risks of changes in forest lands. Some

interventions, while they may look green on paper, may bring unintended consequences. For example, rewilding may bring an increase in biodiversity, but this may also mean a higher incidence of undesirable human-nature interactions. Logging in forest areas and constructing infrastructure for green energy can augment income, but they would disrupt natural processes. Linked to this are the ever-growing challenges of floods as the climate changes and key areas are deforested. These topics were again presented in a video (a sample screenshot of the video is shown in Figure 9), which also begs the question: Are there solutions where no one is left behind?

Figure 9. Screenshot of the video for the cluster on nature and water.

The proposed solutions include establishing zones that prioritise ecological functions across the landscape and heavily restrict land use, creating community regeneration networks of corridors and micro-forests, and establishing voluntary watershed stewardship councils for addressing water-related challenges.

This base simulation can be accessed at: https://engage.socialsimulations.org/PLUSChange-NatureAndWater

3.2 The self-exploration

To experience a base policy simulation, it needs to be operated by a moderator with a group of participants. To provide a simple experience of the simulation that is independently accessible, we developed a self-exploration web application that any individual can navigate through and explore on their own. This self-exploration interface features the narratives presented in the base simulations, including a series of directed videos and stylised geographic maps. The user can fully explore the three stylised areas created for the purposes of the simulation: Verdaterra's Urban zone, Rural zone and area dedicated to Nature & Water. For each of these zones a landscape (side) view and a bird's eye (map) view are available. Each zone features a number of interactive elements for the user to explore, such as visualisations of individual inhabitants or land-use categories (e.g. agriculture, urban sprawl). These elements either carry a piece of information related to land use and land-use change in their respective areas or allow the user

to observe land-use change in time by offering a “past and present” interactive view of a certain area.

The self-exploration application can be accessed at: https://engage.socialsimulations.org/PLUSChange-ExploreVerdaterra

4 Use in the Pathways workshop

The Pathways of Change workshop is a multi-stakeholder workshop where stakeholders will co-create trajectories towards their visions for their respective PCs. The general workshop structure, presented in Figure 10, is mainly divided into two parts: 1) the Policy Simulation, and 2) Pathways Development. The policy simulation tool will be used during the Policy Simulation section of WS4 that will be run by the respective PC partners, where the policy simulation immerses the stakeholder-participants in a process of collective learning, negotiation and consensus-building to develop solutions to their land use and land-use change challenges. During the policy simulation, the participants are also exposed to other voices about the issue or topic to foster concepts of inclusion and fairness in their discussions and, eventually, their solutions.

The Pathways development section of the workshop will have the participants develop pathways for achieving their desired future regarding land use. Developing a pathway involves looking for an interlinked set of potential solutions to the challenges they face, in which the solutions they co-created in the policy simulation section are a subset. The pathways to their vision will be done through the process of back casting.

Based on the general workshop structure, the workshop agenda is being customised individually with each PC partner to fit the context and needs of each PC and its respective stakeholders. The PC partners will run their respective workshops in the local language; thus, the simulation tool will be translated for each PC, and the videos will be provided with the corresponding subtitles. The translations will be done with the help of the PC partners.

As it consists of a web-based application, a digital tool, we are well aware of the potential barriers to the use of the policy simulation tool, especially concerning digital literacy and access. And while the application is designed to be as simple as possible, its operation from the back end by potential operators, such as the PC partners, will still require training. In consideration of these potential barriers, we are providing the option to the PC partners to run the simulation without the use of the web application, and instead use analogue counterparts, such as printed materials, or facilitators taking on pre-defined roles to represent voices or perspectives that are missing among the participants present during the workshop.

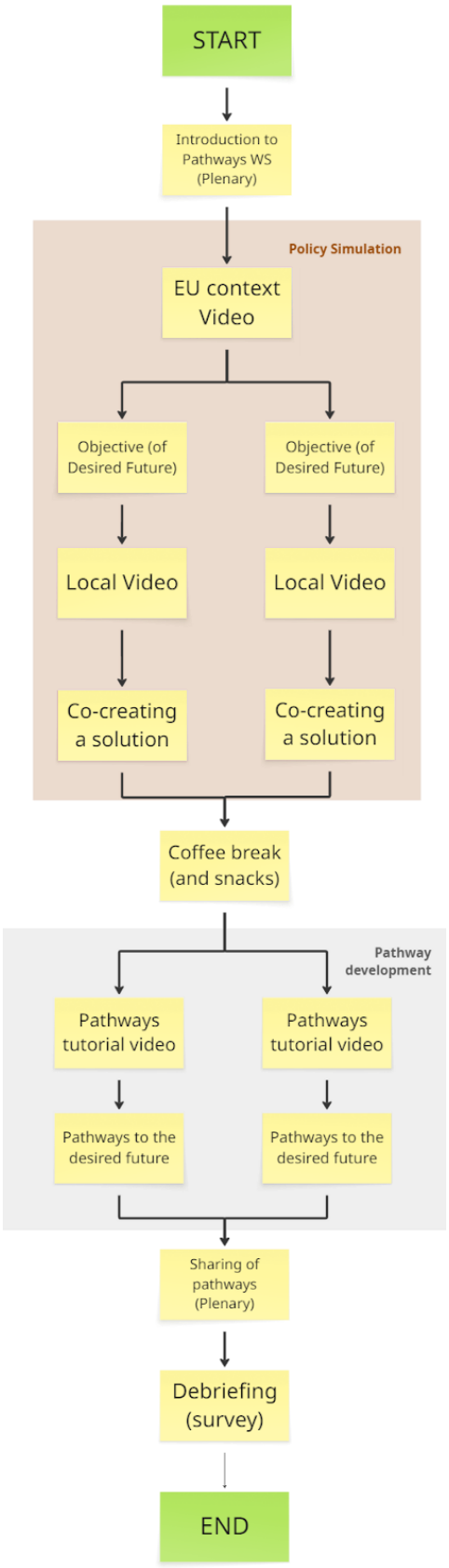

Figure 10. General structure of WS4.

5 Conclusion

This deliverable has outlined the rationale, development, and structure of the Policy Simulation Tools designed to foster collaborative, experiential learning about land use and land-use change. By simulating real-world complexity and embedding participants in a storyline that draws on scientific data, stakeholder knowledge, and plausible future developments, these tools enable meaningful deliberation on sustainability, well-being, and policy choices. Instead of developing unique simulations for each Practice Case, we strategically created three base simulations, clustered by shared concerns, and built a unifying fictional region—*Verdaterra*—that synthesises and reflects the diversity of contexts across all 12 Practice Cases.

The Policy Simulation Tools are used to support the policy simulation process through participant immersion and facilitation of the delivery of information through various media, such as videos and in-app emails. Its various components, if systematically deployed, immerse participants in a collective learning and collaborative environment, and bring forth agency to address and act upon the current challenges they face towards sustainable land use.

This approach balances scalability with specificity, ensuring that local relevance is retained without compromising the feasibility of implementation. The participatory construction of the EU land use diagram and the PC desired futures ensured the legitimacy of the simulations. As the Pathways workshops unfold, these tools will not only support strategic thinking and policy design but also contribute to mutual understanding across diverse actor groups. Ultimately, the Policy Simulation Tools represent a vital mechanism for turning insights into action, supporting systems thinking, stakeholder agency, and transdisciplinary dialogue in the face of land-use change and climate challenges.

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